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PLOTIT-METHOD OF INTERACTIVELY PLOTTING INPUT DATA FOR THE VORLAX COMPUTER PROGRAM

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SUMMARY

A method of plotting the geometric input to the VORLAX computer program by means of an interactive remote computer terminal is described. The software consists of a procedure file and two programs and was developed for use with the Langley Research Center computer system. The programs and procedure file are described and a sample execution is presented.

INTRODUCTION

The VORLAX computer program uses a sparse set of geometric input data to describe the aircraft configuration being analyzed. The geometry of the configuration can at times become very complex, and it is necessary to plot the configuration resulting from the data in order to ascertain its accuracy. The procedure file and two computer programs described herein provide a method for plotting this data at an interactive graphics terminal. A sample execution of the procedure is presented.

Use of this method allows the configuration to be plotted with any combination of roll, pitch, or yaw angles. Three independent forms of data display are available, and these may be specified in any combination. These are: (1) configurations with or without camber, (2) configurations showing only major panels or only minor panels, and (3) configurations with or without control points plotted. Any section of the plot may be enlarged for examination in greater detail.

The procedure file and computer programs to plot the VORLAX input data have been written to be used in the Langley Research Center computer system which provides a Network Operating System (NOS) and a Tektronix Plot 10 package. Langley Research Center users will find the procedure file and computer programs in mass storage as public files in the catalog of user number 214737C.

DISCUSSION

DESCRIPTION OF PROCEDURE FILES AND PROGRAMS

A method has been developed for plotting the VORLAX input data which consists of a procedure file and two computer programs. The procedure file PLOTIT and the computer programs READS and PLOTS are described in the following. A sample execution is provided which includes illustrations of the displays.

Procedure File PLOTIT

Procedure file PLOTIT (Appendix A) is used to simplify the plotting procedure. PLOTIT first gets the desired data file and renames it TAPE1. It then gets the binary form of program READS, which reads the input data and prepares files suitable for the subsequent operations. PLOTIT then gets and executes the binary form of PLOTS, which performs the aircraft geometry plotting.

Program READS

Program READS (Appendix B) reads the VORLAX input data from a disc file named TAPE1 and determines the necessary scaling factor in order for the aircraft drawing to fit on the screen.

The data for each of the panels are then read, and the coordinates of a set of points that describe the panels are calculated. These coordinates are stored on three disc files named TAPE3, TAPE4, and TAPE5. These data files will be read by program PLOTS.

Program READS provides the user with two methods of representing the aircraft. The first method displays the aircraft with camber as shown in figure 1(a). The second method shows the aircraft without camber. Figure 1(b) is the aircraft of figure 1(a) without camber.

Program PLOTS

Program PLOTS (Appendix C) reads the data produced by program READS. This program offers the user several variations in the display which are described in the following sections.

Rotation of the Aircraft. - The initial position of the aircraft is a side view with the nose to the left. From this position, it is possible to rotate the aircraft first in roll, then in pitch, and finally in yaw. Positive angles are defined as follows: roll, right wing down; pitch, nose up; and yaw, nose right.

Additional Independent Variations. - PLOTS offers two additional independent variations in the display. These variations are: (1) with or without subpaneling and (2) with or without control points. Examples of these variations are shown in figures 1(c) through 1(f). Figure 1(c) shows the aircraft without subpaneling or control points; figure 1(d) has subpaneling added; in figure 1(e) control points only have been added; and in figure 1(f) control points and subpaneling have been added. All of the plots are constructed using orthographic projection.

Recovery from Input Errors. - If an error has been made in specifying the input parameters, the execution of PLOTS can be stopped. There are three ways to stop PLOTS while it is executing. These are: (1) enter a value greater than 360 for roll angle, (2) answer any of the questions with STOP, or (3) stop the program while it is plotting by interrupting it with the break key and then entering an S.

Program PLOTS can be restarted at the beginning by sending the command PLOTB to the computer. PLOTB will also restart the program if it is stopped for any other reason.

SAMPLE EXECUTION

Figure 2 shows a sample execution of PLOTIT at a remote terminal. The first command gets the procedure file PLOTIT.

GET,PLOTIT/UN=214737C

The second command initiates the execution of the procedure file.

CALL,PLOTIT(T=VORLAXX)

VORLAXX is the name of the file on which the VORLAX data deck has been stored for this example. The file name in the calling statement can be any name which corresponds to a file on which VORLAX data is stored.

The first question asked by the computer deals with camber in the panels.

DO YOU WANT CAMBER IN THE PANELS ?
TRUE OR FALSE

If camber is desired in the panels, type in TRUE, otherwise type in FALSE and the camber will be set equal to zero.

The next three questions asked by the computer are concerned with the desired roll, pitch, and yaw angles of the configuration, and are as follows.

INPUT THE ROLL ANGLE FOR THE AIRCRAFT
(DEG), > 360 TO STOP.
PITCH ANGLE
YAW ANGLE

The angles desired in degrees, are typed in after the questions. If termination of the program is desired, a value greater than 360 may be typed in for the roll angle.

The next two questions are concerned with the desirability of displaying paneling and control points. The two questions are:

SUBPANELING ? TRUE OR FALSE
CONTROL POINTS ? TRUE OR FALSE

If these questions are answered TRUE, the subpaneling and control points are incorporated into the plots. If they are answered FALSE, then these quantities are deleted. The plot resulting from the input in figure 2 is presented in figure 3.

If a certain section of the plot needs to be enlarged in order to examine the plotted data more closely, this may be accomplished at the terminal. When the computer has finished plotting, it will print the following statement:

FOR ENLARGEMENT INPUT YES

At this point a hard copy can be made if desired. If any reply except YES is typed in, the computer will ask for a new set of angles. If YES is typed in, the graphics cursor (cross hairs) will appear. The cursor should then be located at the lower left corner [fig. 4(a)] of a rectangular region to be enlarged. A non-control keyboard character should be pressed. This will cause the cursor to disappear. The carriage return is then pressed. This sequence sends the coordinates of the first corner to the computer. The graphics cursor will reappear and should be relocated to the upper right corner of the desired rectangular region [fig. 4(b)]. A non-control keyboard character and the carriage return are then pressed as for the first corner. An enlargement of the region defined by these positions of the graphics cursor is shown in figure 4(c).

When the plot is finished, the computer will again print

FOR ENLARGEMENT INPUT YES

This allows a further enlargement of a section of the plot if desired.

CONCLUDING REMARKS

A plotting routine, PLOTIT, has been developed for plotting the input data for the VORLAX computer program. This program allows the user to plot geometric input data interactively at a remote graphics terminal and thereby ascertain very rapidly whether or not the data is correct.

The routine consists of two programs and a procedure file. These have been designed for use on the Control Data Corporation computer system with a Network Operating System (NOS) and a Tektronix Plot 10 graphics package at the NASA Langley Research Center.

REFERENCES

1. Miranda, Luis R.; Elliott, Robert D.; and Baker, William M.: A Generalized Vortex Lattice Method for Subsonic and Supersonic Flow Applications. NASA CR-2865, December 1977.

APPENDIX A

PROCEDURE FILE PLOTIT

This procedure file gets the binary form of READS(READB) and executes it, then gets the binary form of PLOTS (PLOTB) and executes it.

```
PLOTIT.
RETURN,TAPE3,TAPE4,TAPE5.
GET,TAPE1=T.
GET,READB/UN=214737C.
READB.
RETURN,READB.
GET,PLOTB/UN=214737C.
PLOTB.
EXIT.
```

APPENDIX B

SOURCE LISTING OF PROGRAM READS

```
      PROGRAM READS(INPUT,OUTPUT,TAPE1,TAPE4,TAPE2=OUTPUT,TAPE3,TAPE5)
C           THIS PROGRAM READS THE INPUT DATA FOR THE VORLAX PROGRAM
C           SO IT CAN BE PLOTED.
      DIMENSION TITLE(8)
      COMMON/BLOCK/XOFFSET
      LOGICAL CAMBER
      REAL LENGTH
      READ(1,100)TITLE
      READ(1,103)LAX,LAY
      READ(1,101)
      READ(1,102)NPAN,WSPAND
      CALL SIZES(NPAN,LENGTH,XOFFSET,WSPAN)
      IF(WSPAND.GT.WSPAN)WSPAN=WSPAND
      TESTRTO=LENGTH/WSPAN
      IF(LENGTH.GT.WSPAN)WSPAN=LENGTH
C        REALY IS THE WIDTH OF THE PLOTTING SURFACE.
      WRITE(3)NPAN,TITLE,TESTRTO
      REALY=10.0
      REALY=REALY-.20
      SCALE=REALY/WSPAN
      XOFFSET=-(XOFFSET+WSPAN*.5)
      WRITE(2,104)
      READ 105,CAMBER
      DO 200 I=1,NPAN
  200 CALL PANLRED(SCALE,LAX,LAY,CAMBER)
  100 FORMAT(8A10)
  101 FORMAT(//)
  102 FORMAT(I2,48X,F10.0)
  103 FORMAT(11X,I1,9X,I1)
  104 FORMAT("DO YOU WANT CAMBER IN THE PANELS ?  ",/,"TRUE OR FALSE")
  105 FORMAT(L7)
      STOP
      END
```

```
      SUBROUTINE PANLRED(SCALE,LAX,LAY,CAMBER)
      COMMON/BLOCK/XOFFSET
      COMMON/BLOKO/NAP,XAF(50),ZC(2,50),CORD1,CORD2,CD1SIN,CD2SIN
      COMMON/CANDS/SIN1,SIN2,COS1,COS2,DELTAY
      COMMON/ROJ1/ROJ,CROSSIZ
      LOGICAL CAMBER
      INTEGER PRD,RNCV
C
C       THIS SUBROUTINE READS THE VORLAX DATA FOR A PANEL,EACH TIME IT
C       IS CALLED.  THE COORDINATES OF A SET OF POINTS THAT DESCRIBE
C       THE PANEL ARE CALCULATED AND STORED ON DISC.
C
      DIMENSION X(2),Y(2),Z(2),CORD(2),RLE(2)
      COMMON/PHIRO/ PHI(100),RO(100),SINE(100),COSINE(100)
      COMMON VORS(3,500)
      COMMON/PI/PIE
      COMMON/TWIST/AINC1,DAINC
      REAL K
      DATA PIE/3.14159/,CROSSIZ/.02/
C
C       THIS SECTION READS THE VORLAX DATA CARDS FOR A PANEL.
C
      DO 200 I=1,2
  200 READ(1,100)X(I),Y(I),Z(I),CORD(I)
      DO 250 I=1,2
      X(I)=(X(I)+XOFFSET)*SCALE
      Y(I)=Y(I)*SCALE
      Z(I)=Z(I)*SCALE
  250 CORD(I)=CORD(I)*SCALE
      READ(1,101)TVOR,TNCV,PDL
      RNCV=INT(TNCV)
      NVOR=INT(TVOR)
      NVOR1=NVOR+1
      IF(PDL.LE.360.)GO TO 1
      READ(1,102)(PHI(N),RO(N),N=1,NVOR1)
      DO 251 N=1,NVOR1
      PHI(N)=PHI(N)*3.14159/180.
  251 RO(N)=RO(N)*SCALE
```

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```
    1 READ(1,103)AINC1,AINC2,ITS,NAP,IQUANT,ISYNT,NPP                   READS    72
      AINC1=ATAN(AINC1)                                                 READS    73
      AINC2=ATAN(AINC2)                                                 READS    74
      DAINC=AINC2-AINC1                                                 READS    75
      IF(IQUANT.EQ.0)IQUANT=2                                           READS    76
      IF(ISYNT.NE.0)READ(1,104)                                         READS    77
      IF(NAP.LE.2)GO TO 2                                               READS    78
      READ(1,102)(XAF(I),I=1,NAP)                                       READS    79
      DO 88 I=1,NAP                                                     READS    80
   88 XAF(I)=XAF(I)*.01                                                 READS    81
      IF(ITS.EQ.0.OR.PDL.GE.360.)GO TO 3                                READS    82
      READ(1,105)RLE(1)                                                 READS    83
      RLE(1)=RLE(1)*SCALE                                               READS    84
    3 READ(1,102)(ZC(1,I),I=1,NAP)                                      READS    85
      IF(ITS.EQ.0.OR.PDL.GT.360.)GO TO 4                                READS    86
      READ(1,105)RLE(2)                                                 READS    87
      RLE(2)=RLE(2)*SCALE                                               READS    88
    4 READ(1,102)(ZC(2,I),I=1,NAP)                                      READS    89
      IF(.NOT.CAMBER.A.NAP.GT.2)CALL  ZEROZC1(PDL)                      READS    90
    2 CONTINUE                                                          READS    91
  100 FORMAT(4F10.0)                                                    READS    92
  101 FORMAT(2F10.0,10X,F10.0)                                          READS    93
  102 FORMAT(8F10.0)                                                    READS    94
  103 FORMAT(2F10.0,I2,8X,I2,9X,I1,9X,I1,9X,I1)                         READS    95
  104 FORMAT(/)                                                         READS    96
  105 FORMAT(F10.0)                                                     READS    97
C                                                                       READS    98
C        THIS SECTION CALCULATES THE LOCATION OF A SET OF POINTS        READS    99
C        THAT DEFINE A FLAT PANEL.                                      READS   100
C                                                                       READS   101
      NVRN=(RNCV)*(NVOR+1)+1                                            READS   102
      NVRNPRD=(RNCV+2)*(NVOR+1)                                         READS   103
      N4= 4.0*RNCV                                                      READS   104
      N2=2.0*RNCV                                                       READS   105
      X1=X(1)                                                           READS   106
      CORD1=CORD(1)                                                     READS   107
C*****   IF THE PANEL IS CURVED GO TO 5                                 READS   108
      IF(PDL.GT.360.)GO TO 5                                            READS   109
      X2=X(2)                                                           READS   110
```

```
      Y1=Y(1)
      CORD2=CORD(2)
      SIN1=SIN(AINC1)
      SIN2=SIN(AINC2)
      COS1=COS(AINC1)
      COS2=COS(AINC2)
      CD1SIN=CORD1*SIN1
      CD1COS=CORD1*COS1
      CD2SIN=CORD2*SIN2
      CD2COS=CORD2*COS2
      Z1=Z(1)
      Z2=Z(2)
      DELTAY=(Y(2)-Y1)
      DELTAX=(X2-X1)
      DELTAZ=(Z2-Z1)
      DELTACO=(CD2COS-CD1COS)
      YRAT=SQRT(DELTAZ*DELTAZ+DELTAY*DELTAY)
C
      ISETS=ISETSF(NVRNPRD)
      CALL  SAVE(IFUG,3,IDUM,1)
      WRITE(3)NVOR,RNCV,PDL,IQUANT,NVRNPRD,ISETS
      CALL  INTERP(0.0,ZZO,ZZ,XOO,XERP)
      DO 310  I=1,NVOR1
      IF(LAY.EQ.1)RATIO=(I-1.)/NVOR
      IF(LAY.EQ.0)RATIO=.5*(1.-COS(PIE*(I-1.)/NVOR))
      VORS(1,I)=X1+XOO+RATIO*(DELTAX+XERP)
      VORS(2,I)=Y1+DELTAY*RATIO
  310 VORS(3,I)=ZZO+RATIO*(ZZ+DELTAZ)+Z1
C
      DO 501  I=NVOR1,NVRN,NVOR1
      IF(LAX.EQ.1)PCORD=(I/NVOR1*4.0-3.0)/N4
      IF(LAX.EQ.0)PCORD=.5*(1.-COS((2.*I/NVOR1-1.)*PIE/N2))
      CALL  INTERP(PCORD,ZZO,ZZ,XOO,XERP)
      DO 501  J=1,NVOR1
      I2=I+J+IFUG
      IF(LAY.EQ.1)RATIO=(J-1.)/NVOR
      IF(LAY.EQ.0)RATIO=.5*(1.-COS(PIE*(J-1.)/NVOR))
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      VORS(2,I2)=Y1+DELTAY*RATIO                                        READS
      VORS(3,I2)=Z1+DELTAZ*RATIO                                        READS
      XCORD=CD1COS+(DELTACO)*RATIO                                      READS
      XX=X1+RATIO*(DELTAX)                                              READS
      VORS(3,I2)=VORS(3,I2)+ZZO+ZZ*RATIO                                READS
      VORS(1,I2)=XX+PCORD*XCORD+XOO+RATIO*XERP                          READS
  501 IF(I2.EQ.500)CALL SAVE(IFUG,3,IDUM,2)                             READS
      CALL INTERP(1.0,ZZO1,ZZ1,XOO1,XERP1)                              READS
      DO 300 I=1,NVOR1                                                  READS
      I2=NVRN+NVOR1+I-1+IFUG                                            READS
      IF(LAY.EQ.1)RATIO=(I-1.)/NVOR                                     READS
      IF(LAY.EQ.0)RATIO=.5*(1.-COS(PIE*(I-1.)/NVOR))                    READS
      VORS(2,I2)=Y1+DELTAY*RATIO                                        READS
      VORS(3,I2)=ZZO1+RATIO*(ZZ1+DELTAZ)+Z1                             READS
      VORS(1,I2)=(DELTAX+DELTACO+XERP1)*RATIO+X1+CD1COS+XOO1            READS
  300 IF(I2.EQ.500)CALL SAVE(IFUG,3,IDUM,2)                             READS
      CALL SAVE(IFUG,3,NVRNPRD,3)                                       READS
C                                                                       READS
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * READS
C                                                                       READS
C           THIS SECTION OF THE PROGRAM CALCULATES THE LOCATION OF THE  READS
C           CONTROL POINTS FOR A FLAT PANEL SUCH AS A WING.  IT THEN    READS
C           PLACES AN "X" ON EACH POINT.                                READS
      PRD=NVOR*RNCV                                                     READS
      NNO=(RNCV-1)*NVOR+1                                               READS
      NNN=PRD*4                                                         READS
      ISETS=ISETSF(NNN)                                                 READS
      WRITE(4)NVOR,RNCV,PRD,NNN,NNN,NNO,ISETS                           READS
      CALL SAVE(IFUG,4,IDUM,1)                                          READS
      DO 1001 I=1,NNO,NVOR                                              READS
      K=(I-1)/NVOR+1                                                    READS
      IF(LAX.EQ.0)PCORD=.5*(1.-COS(K*PIE/RNCV))                         READS
      IF(LAX.EQ.1)PCORD=(4.*K-1.)/N4                                    READS
      CALL INTERP(PCORD,ZZO,ZZ,XOO,XERP)                                READS
      YRAT=SQRT(DELTAY*DELTAY+(DELTAZ+ZZ)**2.)                          READS
      V1=CROSSIZ*DELTAY/YRAT                                            READS
      V2=CROSSIZ*(DELTAZ+ZZ)/YRAT                                       READS
      DO 1001 J=1,NVOR                                                  READS
```

```
      J2=(I+J-2)*4+IFUG                                                 READS     186
      J21=J2+1                                                          READS     187
      J22=J2+2                                                          READS     188
      J23=J2+3                                                          READS     189
      J24=J2+4                                                          READS     190
      IF(LAY.EQ.1)RATIO=(J-.5)/NVOR                                     READS     191
      IF(LAY.EQ.0)RATIO=.25*(2.-COS(PIE*J/NVOR)-COS(PIE*(J-1.)/NVOR))   READS     192
      CALL ANGLE(RATIO,WS,WC)                                           READS     193
      XCORD=CD1COS+DELTACO*RATIO                                        READS     194
      TEMX=X1+RATIO*(DELTAX+XERP)+PCORD*XCORD+X00                       READS     195
      VORS(1,J21)=TEMX-CROSSIZ*WC                                       READS     196
      VORS(1,J22)=TEMX+CROSSIZ*WC                                       READS     197
      VORS(1,J23)=VORS(1,J24)=TEMX                                      READS     198
      TEMY=Y1+DELTAY*RATIO                                              READS     199
      VORS(2,J21)=VORS(2,J22)=TEMY                                      READS     200
      TEMZ=Z1+DELTAZ*RATIO                                              READS     201
      TEMZ=TEMZ+ZZ0+ZZ*RATIO                                            READS     202
      VORS(3,J21)=TEMZ-CROSSIZ*WS                                       READS     203
      VORS(3,J22)=TEMZ+CROSSIZ*WS                                       READS     204
      VORS(3,J23)=TEMZ-V2                                               READS     205
      VORS(3,J24)=TEMZ+V2                                               READS     206
      VORS(2,J23)=TEMY-V1                                               READS     207
      VORS(2,J24)=TEMY+V1                                               READS     208
      IF(J24.EQ.500)CALL SAVE(IFUG,4,IDUM,2)                            READS     209
 1001 CONTINUE                                                          READS     210
      CALL SAVE(IFUG,4,NNN,3)                                           READS     211
 1010 CONTINUE                                                          READS     212
      RETURN                                                            READS     213
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * READS     214
C       THIS SECTION OF THE PROGRAM IS FOR CURVED MAJOR PANELS.         READS     215
C                                                                       READS     216
    5 YNOT=Y(1)-RO(1)*COS(PHI(1))                                       READS     217
      ZNOT=Z(1)-RO(1)*SIN(PHI(1))                                       READS     218
      TEMP2=X1+CORD1                                                    READS     219
C        THIS CALCULATES THE SCALING FACTORS FOR THE RADIUS VECTORS     READS     220
C        FROM AREA RATIOS.                                              READS     221
      IF(NAP.LE.2)GO TO 90                                              READS     222
      DO 89 J=1,NAP                                                     READS     223
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   89 ZC(2,J)=SQRT(ZC(2,J)*.01)                                        READS  224
C                                                                      READS  225
C        THIS SECTION CALCULATES THE LOCATION OF A SET OF POINTS THAT  READS  226
C        DESCRIBE A CURVED MAJOR PANEL SUCH AS A FUSELAGE OR A NACELLE READS  227
C        WITH SUBPANELING.                                             READS  228
C                                                                      READS  229
   90 CALL INTERP2(0.0,XSHFT1,SKAL1,DM,DM,ZSHFT1,DM,9H NO POINT)       READS  230
      CALL SAVE(IFUG,5,IDUM,1)                                         READS  231
      ISETS=ISETSF(NVRNPRD)                                            READS  232
      WRITE(5)NVOR,RNCV,NVRNPRD,ISETS                                  READS  233
      DO 1333 I=1,NVOR1                                                READS  234
      R=RO(I)                                                          READS  235
      FI=PHI(I)                                                        READS  236
      VORS(1,I)=X1                                                     READS  237
      VORS(2,I)=R*COS(FI)*SKAL1+YNOT                                   READS  238
 1333 VORS(3,I)=R*SIN(FI)*SKAL1+ZNOT+ZSHFT1                            READS  239
C                                                                      READS  240
      DO 1501 I=NVOR1,NVRN,NVOR1                                       READS  241
      IF(LAX.EQ.1)PCORD=(I/NVOR1*4.-3.)/N4                             READS  242
      IF(LAX.EQ.0)PCORD=.5*(1.-COS((2.*I/NVOR1-1.)*PIE/N2))            READS  243
      CALL INTERP2(PCORD,XSHIFT,SKAL,DM,DM,ZSHIFT,DM,9H NO POINT)      READS  244
      XTEMP=X1+XSHIFT                                                  READS  245
      DO 1501 J=1,NVOR1                                                READS  246
      I2=I+J+IFUG                                                      READS  247
      R=RO(J)*SKAL                                                     READS  248
      FI=PHI(J)                                                        READS  249
      VORS(1,I2)=XTEMP                                                 READS  250
      VORS(2,I2)=R*COS(FI)+YNOT                                        READS  251
      VORS(3,I2)=R*SIN(FI)+ZNOT+ZSHIFT                                 READS  252
 1501 IF(I2.EQ.500)CALL SAVE(IFUG,5,IDUM,2)                            READS  253
      CALL INTERP2(1.0,XSHFT2,SKAL2,DM,DM,ZSHFT2,DM,9H NO POINT)       READS  254
      DO 1300 I=1,NVOR1                                                READS  255
      I2=NVRN+NVOR1+I-1+IFUG                                           READS  256
      R=RO(I)                                                          READS  257
      FI=PHI(I)                                                        READS  258
      VORS(1,I2)=TEMP2                                                 READS  259
      VORS(2,I2)=R*SKAL2*COS(FI)+YNOT                                  READS  260
      VORS(3,I2)=R*SKAL2*SIN(FI)+ZNOT+ZSHFT2                           READS  261
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```
 1300 IF(I2.EQ.500)CALL SAVE(IFUG,5,IDUM,2)                                READS
      CALL SAVE(IFUG,5,NVRNPRD,3)                                          READS
C                                                                          READS
C        THIS SECTION CALCULATES THE LOCATION OF A SET OF POINTS THAT      READS
C        DESCRIBE A CURVED MAJOR PANEL, WITHOUT SUBPANELING.               READS
      NVRN=(NAP)*(NVOR+1)                                                  READS
      NVRNPRD=(NAP)*(NVOR+1)                                               READS
      ISETS=ISETSF(NVRNPRD)                                                READS
      WRITE(3)NVOR ,NAP ,PDL,IQUANT,NVRNPRD,ISETS                          READS
      CALL SAVE(IFUG,3,NVRNPRD,1)                                          READS
      IF(NAP.LE.2)GO TO 556                                                READS
      DO 555 I=1,NVRN,NVOR1                                                READS
      II=(I)/NVOR1+1                                                       READS
      XTEMP=X1+CORD1*XAF(II)                                               READS
      SKAL=ZC(2,II)                                                        READS
      DO 555 J=1,NVOR1                                                     READS
      R=RO(J)*SKAL                                                         READS
      FI=PHI(J)                                                            READS
      I2=I+J-1+IFUG                                                        READS
      VORS(1,I2)=XTEMP                                                     READS
      VORS(2,I2)=R*COS(FI)+YNOT                                            READS
      VORS(3,I2)=R*SIN(FI)+ZNOT+CORD1*.01*ZC(1,II)                         READS
  555 IF(I2.EQ.500)CALL SAVE(IFUG,3,IDUM,2)                                READS
      IF(NAP.GT.2)GO TO 5555                                               READS
  556 NAP=2                                                                READS
      NVRNPRD=NAP*NVOR1                                                    READS
      DO 5554 J=1,NVOR1                                                    READS
      J2=J+NVOR1                                                           READS
      VORS(1,J)=X1                                                         READS
      VORS(1,J2)=X1+CORD1                                                  READS
      VORS(2,J)=VORS(2,J2)=YNOT+RO(J)*COS(PHI(J))                          READS
 5554 VORS(3,J)=VORS(3,J2)=ZNOT+RO(J)*SIN(PHI(J))                          READS
 5555 CALL SAVE(IFUG,3,NVRNPRD,3)                                          READS
C                                                                          READS
C        THIS SECTION CALCULATES THE LOCATION OF THE CONTROL POINTS FOR    READS
C        A CURVED MAJOR PANEL.  IT THEN PLACES AN "X" ON EACH POINT.       READS
      ROJ=RO(1)                                                            READS
      DO 2010 N=1,NVOR                                                     READS
```

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```
      AZ0=RO(N)*SIN(PHI(N))                                    READS    300
      AZ1=RO(N+1)*SIN(PHI(N+1))                                READS    301
      AY0=RO(N)*COS(PHI(N))                                    READS    302
      AY1=RO(N+1)*COS(PHI(N+1))                                READS    303
      DAZ=AZ0-AZ1                                              READS    304
      DAY=AY0-AY1                                              READS    305
      H=SQRT(DAZ*DAZ+DAY*DAY)                                  READS    306
      SINE(N)=DAZ/H                                            READS    307
      COSINE(N)=DAY/H                                          READS    308
      R1=RO(N)                                                 READS    309
      R2=RO(N+1)                                               READS    310
      F1=PHI(N)                                                READS    311
      F2=PHI(N+1)                                              READS    312
      RO(N)= (R1*SIN(F1)+R2*SIN(F2))*.5                        READS    313
 2010 PHI(N)=(R1*COS(F1)+R2*COS(F2))*.5                        READS    314
      PRD=NVOR*RNCV                                            READS    315
      NNO=(RNCV-1)*NVOR+1                                      READS    316
      NNN=PRD*4                                                READS    317
      ISETS=ISETSF(NNN)                                        READS    318
      WRITE(4)NVOR,RNCV,PRD,NNN,NNN,NNO,ISETS                  READS    319
      CALL SAVE(IFUG,4,IDUM,1)                                 READS    320
      DO 2001 I=1,NNO,NVOR                                     READS    321
      K=(I-1)/NVOR+1                                           READS    322
      IF(LAX.EQ.0)PCORD=.5*(1.-COS(K*PIE/RNCV))                READS    323
      IF(LAX.EQ.1)PCORD=(4.*K-1.)/N4                           READS    324
      CALL INTERP2(PCORD,TEMX,SKAL,DSKL,CROSX,CAMB,DZ,6HPOINTS) READS    325
      TEMX=TEMX+X1                                             READS    326
      DO 2001 J=1,NVOR                                         READS    327
      J2=(I+J-2)*4+IFUG                                        READS    328
      J21=J2+1                                                 READS    329
      J22=J2+2                                                 READS    330
      J23=J2+3                                                 READS    331
      J24=J2+4                                                 READS    332
      VS=SINE(J)*CROSSIZ                                       READS    333
      HS=COSINE(J)*CROSSIZ                                     READS    334
      TEMY=PHI(J)*SKAL+YNOT                                    READS    335
      TY2=DSKL*PHI(J)                                          READS    336
      TEMZ=RO(J)*SKAL+ZNOT+CAMB                                READS    337
```

```
      TZ2=RO(J)*DSKL+DZ                                                 READS 338
      VORS(1,J21)=TEMX-CROSX                                            READS 339
      VORS(1,J22)=TEMX+CROSX                                            READS 340
      VORS(1,J23)=TEMX                                                  READS 341
      VORS(1,J24)=TEMX                                                  READS 342
      VORS(2,J21)=TEMY-TY2                                              READS 343
      VORS(2,J22)=TEMY+TY2                                              READS 344
      VORS(2,J23)=TEMY-HS                                               READS 345
      VORS(2,J24)=TEMY+HS                                               READS 346
      VORS(3,J21)=TEMZ-TZ2                                              READS 347
      VORS(3,J22)=TEMZ+TZ2                                              READS 348
      VORS(3,J23)=TEMZ-VS                                               READS 349
      VORS(3,J24)=TEMZ+VS                                               READS 350
      IF(J24.EQ.500)CALL SAVE(IFUG,4,IDUM,2)                            READS 351
 2001 CONTINUE                                                          READS 352
      CALL SAVE(IFUG,4,NNN,3)                                           READS 353
      RETURN                                                            READS 354
      END                                                               READS 355

      SUBROUTINE INTERP(P,ZA,Z,XA,X)                                    READS 356
C       THIS SUBROUTINE DOES THE INTERPOLATION FOR CAMBER OF A FLAT     READS 357
C       MAJOR PANEL.                                                    READS 358
      COMMON/BLOKO/NAP,XAF(50),ZC(2,50),CORD1,CORD2,CD1SIN,CD2SIN       READS 359
      COMMON/CANDS/SIN1,SIN2,COS1,COS2,DELTAY                           READS 360
      COMMON/TWIST/AINC1,DAINC                                          READS 361
      COMMON/SLOPE/ANGL,DANG                                            READS 362
      IF(NAP.LE.2.OR.DELTAY.EQ.0.0)GO TO 3                              READS 363
      DO 1 I=2,NAP                                                      READS 364
    1 IF(P.LE.XAF(I))GO TO 2                                            READS 365
    2 DAF=XAF(I)-XAF(I-1)                                               READS 366
      DZC1=ZC(1,I)-ZC(1,I-1)                                            READS 367
      DZC2=ZC(2,I)-ZC(2,I-1)                                            READS 368
      A1=ATAN(DZC1/DAF*.01)                                             READS 369
      A2=ATAN(DZC2/DAF*.01)                                             READS 370
      DAA=A2-A1                                                         READS 371
      PC=(P-XAF(I-1))/DAF                                               READS 372
      CAMB1=(DZC1*PC+ZC(1,I-1))*CORD1*.01                               READS 373
```

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```
      CAMB2=(DZC2*PC+ZC(2,I-1))*CORD2*.01                               READS
      GO TO 4                                                           READS
    3 CAMB1=CAMB2=A1=DAA=0.0                                            READS
    4 DANG=DAA+DAINC                                                    READS
      ANGL=AINC1+A1                                                     READS
      ZA=CAMB1*COS1+P*CD1SIN                                            READS
      ZB=CAMB2*COS2+P*CD2SIN                                            READS
      Z=ZB-ZA                                                           READS
      XA=-CAMB1*SIN1                                                    READS
      XB=-CAMB2*SIN2                                                    READS
      X=XB-XA                                                           READS
      RETURN                                                            READS
      END                                                               READS
C                                                                       READS


      SUBROUTINE INTERP2(P,X,S,DS,CROS,Z,DZ,TEST)                       READS
C       THIS SUBROUTINE DOES THE INTERPOLATION FOR THE RADIUS VECTORS   READS
C       AND THE CAMBER OF A CURVED MAJOR PANEL.                         READS
      COMMON/BLOKO/NAP,XAF(50),ZC(2,50),CORD1,CORD2,CD1SIN,CD2SIN       READS
      COMMON/ROJ1/ROJ,CROSSIZ                                           READS
      X=P*CORD1                                                         READS
      IF(NAP.LE.2)GO TO 3                                               READS
      DO 1 I=2,NAP                                                      READS
    1 IF(P.LE.XAF(I))GO TO 2                                            READS
    2 DAF=XAF(I)-XAF(I-1)                                               READS
      DZC1=ZC(1,I)-ZC(1,I-1)                                            READS
      DZC2=(ZC(2,I)-ZC(2,I-1))                                          READS
      PC=(P-XAF(I-1))/DAF                                               READS
      S=ZC(2,I-1)+DZC2*PC                                               READS
      Z=ZC(1,I-1)+DZC1*PC                                               READS
      Z=Z*.01*CORD1                                                     READS
      IF(TEST.NE.6HPOINTS)RETURN                                        READS
      DRAD=ROJ*DZC2                                                     READS
      DELX=DAF*CORD1                                                    READS
      COSINE=DELX/SQRT(DRAD*DRAD+DELX*DELX)                             READS
      CROS=COSINE*CROSSIZ                                               READS
      P2=CROS/CORD1                                                     READS
```

```
      PC2=(P+P2-XAF(I-1))/DAF                                           READS
      S2=ZC(2,I-1)+DZC2*PC2                                             READS
      Z2=ZC(1,I-1)+DZC1*PC2                                             READS
      Z2=Z2*CORD1*.01                                                   READS
      DZ=Z2-Z                                                           READS
      DS=S2-S                                                           READS
      RETURN                                                            READS
    3 S=S2=1.0                                                          READS
      Z=DS=DZ=0.0                                                       READS
      CROS=CROSSIZ                                                      READS
      RETURN                                                            READS
      END                                                               READS

      SUBROUTINE ANGLE(R,S,C)                                           READS
C      THIS SUBROUTINE IS USED FOR PLACING X'S ON CONTROL POINTS,       READS
C      ON FLAT MAJOR PANELS.                                            READS
      COMMON/SLOPE/ANGL,DANG                                            READS
      ANG=ANGL+R*DANG                                                   READS
      S=SIN(ANG)                                                        READS
      C=COS(ANG)                                                        READS
      RETURN                                                            READS
      END                                                               READS
C                                                                       READS

      SUBROUTINE ZEROZC1(PDL)                                           READS
C      THIS SUBROUTINE REMOVES CAMBER FROM THE MAJOR PANELS.            READS
      COMMON/BLOKO/NAP,XAF(50),ZC(2,50),CORD1,CORD2,CD1SIN,CD2SIN       READS
      DO 1 I=1,2                                                        READS
      IF(I.EQ.2.A.PDL.GE.360.)RETURN                                    READS
      DO 1 J=1,NAP                                                      READS
    1 ZC(I,J)=0.0                                                       READS
      RETURN                                                            READS
      END                                                               READS
C                                                                       READS
```

```
      FUNCTION ISETSF(N)                                                READS  442
C      THIS FUNCTION DETERMINES THE NUMBER OF DATA SETS NEEDED TO      READS  443
C      TC DESCRIBE A MAJOR PANNEL.                                     READS  444
      R=1.0/500.*N                                                      READS  445
      ISETSF=INT(R)                                                     READS  446
      IF(ISETSF.LT.R)ISETSF=ISETSF+1                                    READS  447
      RETURN                                                            READS  448
      END                                                               READS  449
C                                                                       READS  450

      SUBROUTINE SAVE(FUG,FILE,PROD,TEST)                               READS  451
C      THIS SUBROUTINE MAKES IT POSSIBLE TO REDUCE CORE REQUIREMENTS   READS  452
C      BY REDUCING ARRAY SIZE.                                         READS  453
      INTEGER FUG,FILE,PNTS,TEST,PROD                                   READS  454
      COMMON VORS(3,500)                                                READS  455
      IF(TEST.EQ.2)GO TO 2                                              READS  456
      IF(TEST.EQ.3)GO TO 3                                              READS  457
      FUG=0                                                             READS  458
      RETURN                                                            READS  459
    2 FUG=FUG-500                                                       READS  460
      WRITE(FILE)((VORS(I,J),I=1,3),J=1,500)                            READS  461
      RETURN                                                            READS  462
    3 PNTS=MOD(PROD,500)                                                READS  463
      IF(PNTS.EQ.0)RETURN                                               READS  464
      WRITE(FILE)((VORS(I,J),I=1,3),J=1,PNTS)                           READS  465
      RETURN                                                            READS  466
      END                                                               READS  467
C                                                                       READS  468

      SUBROUTINE SIZES(NPAN,LENGTH,XOFFSET,WIDTH)                       READS  469
C **  DETERMINES THE LENGTH, WIDTH, STARTING POINT OF THE               READS  470
C **  AIRCRAFT.                                                         READS  471
      REAL LENGTH                                                       READS  472
      NPAN2=NPAN-1                                                      READS  473
      CALL FIND(LENGTH,XOFFSET,WIDTH)                                   READS  474
      IF(NPAN.EQ.1)GO TO 8                                              READS  475
```

```
      DO 7 I=1,NPAN2                                              READS    476
      CALL FIND(BIG,SMALL,WIDE)                                   READS    477
      IF(SMALL.LT.XOFFSET)XOFFSET=SMALL                           READS    478
      IF(WIDE.GT.WIDTH)WIDTH=WIDE                                 READS    479
    7 IF(BIG.GT.LENGTH)LENGTH=BIG                                 READS    480
      WIDTH=WIDTH*2.0                                             READS    481
      LENGTH=LENGTH-XOFFSET                                       READS    482
    8 REWIND 1                                                    READS    483
      READ(1,5)                                                   READS    484
    5 FORMAT(/////)                                               READS    485
      RETURN                                                      READS    486
      END                                                         READS    487
C                                                                 READS    488


      SUBROUTINE FIND(BIG,SMALL,WIDE)                             READS    489
C **  DETERMINES THE STARTING POINT, END POINT, AND               READS    490
C **  DISTANCE FROM THE AXIS FOR A PANEL.                         READS    491
      COMMON/BLOKO/NAP,XAF(50),ZC(2,50),CORD1,CORD2,CD1SIN,CD2SIN READS    492
      COMMON/PHIRO/ PHI(100),RO(100),SINE(100),COSINE(100)        READS    493
      READ(1,100)X1,Y1,Z1,CORD1                                   READS    494
      READ(1,100)X2,Y2,Z2,CORD2                                   READS    495
      Y1=ABS(Y1)                                                  READS    496
      Y2=ABS(Y2)                                                  READS    497
      READ(1,101)TVOR,TNCV,PDL                                    READS    498
      NVOR1=INT(TVOR)+1                                           READS    499
      IF(PDL.LE.360.)GO TO 1                                      READS    500
      READ(1,102)(PHI(N),RO(N),N=1,NVOR1)                         READS    501
    1 READ(1,103)AINC1,AINC2,ITS,NAP,IQUANT,ISYNT,NPP             READS    502
      IF(ISYNT.NE.0)READ(1,104)                                   READS    503
      IF(NAP.LE.2)GO TO 2                                         READS    504
      READ(1,102)(XAF(I),I=1,NAP)                                 READS    505
      IF(ITS.EQ.0.OR.PDL.GE.360.)GO TO 3                          READS    506
      READ(1,105)R                                                READS    507
    3 READ(1,102)(ZC(1,I),I=1,NAP)                                READS    508
      IF(ITS.EQ.0.OR.PDL.GT.360.)GO TO 4                          READS    509
      READ(1,105)R                                                READS    510
```

```
    4 READ(1,102)(ZC(2,I),I=1,NAP)                              READS    511
    2 CONTINUE                                                  READS    512
  100 FORMAT(4F10.0)                                            READS    513
  101 FORMAT(2F10.0,10X,F10.0)                                  READS    514
  102 FORMAT(8F10.0)                                            READS    515
  103 FORMAT(2F10.0,I2,8X,I2,9X,I1,9X,I1,9X,I1)                 READS    516
  104 FORMAT(/)                                                 READS    517
  105 FORMAT(F10.0)                                             READS    518
C                                                               READS    519
      SMALL=X2                                                  READS    520
      IF(X1.LT.SMALL)SMALL=X1                                   READS    521
   11 X1=X1+CORD1                                               READS    522
      X2=X2+CORD2                                               READS    523
      BIG=X2                                                    READS    524
      IF(X1.GT.BIG)BIG=X1                                       READS    525
      WIDE=Y1                                                   READS    526
      IF(Y2.GT.WIDE)WIDE=Y2                                     READS    527
      RETURN                                                    READS    528
      END                                                       READS    529
```

APPENDIX C

SOURCE LISTING OF PROGRAM PLOTS

```
      PROGRAM PLOTS(INPUT,OUTPUT,TAPE2=OUTPUT,TAPE3,TAPE4,TAPE5)
C       THIS INITIALIZES THE PLOTTING ROUTINES AND CALLS PLOTPAN.
      CALL INITT(120)
      CALL TERM(3,4096)
      CALL CHRSIZ(4)
      CALL PLOTPAN
      CALL FINITT(0,0)
      STCP
      END
C


      SUBROUTINE PLOTPAN
      COMMON VORS(3,500)
      COMMON /PRAMS/NVOR,NVRNPRD,RNCV,NVOR1,NVRN
      COMMON /TITL/ TITLE(6)
      COMMON /ROT/KARRAY2(7),AMYTRIX(3,3)
      INTEGER RNCV
C
C        THIS PROGRAM READS A SET OF 3 ANGLES AND PLOTS THE
C        CONFIGURATION AFTER ROTATING IT THROUGH THE INDICATED ANGLES.
C        FIRST ONE SIDE IS PLOTTED THEN IT IS REFLECTED THROUGH
C        ITS X-Z PLANE AND THE OTHER SIDE IS PLOTTED.
C        THE ROTATIONS ARE CARIED OUT BY MATRIX MULTPICATION.
C        IT IS ALSO DETERMINED IF THE SUBPANELING AND CONTRUL
C        POINTS ARE TO BE SHOWN.
C
      LOGICAL  SUBLINE,CPONTZ
      DATA (KARRAY2(M),M=1,7)/20,3, 3,500,3,3,3/
      DATA PIE/3.14159/
    9 REWIND 3
      REWIND 4
      REWIND 5
```

```
      READ(3)NPAN,TITLE,TESTRTO                                         PLOTS
C                                                                       PLOTS
C        HERE THE ANGLES OF ROTATION ARE READ; ROLL, PITCH, AND YAW,    PLOTS
C        ARE READ.                                                      PLOTS
C                                                                       PLOTS
      CALL ERASE                                                        PLOTS
      WRITE(2,104)                                                      PLOTS
      READ *,ROLL                                                       PLOTS
      IF(ROLL.GT.360.)RETURN                                            PLOTS
      WRITE(2,105)                                                      PLOTS
      READ *, PITCH                                                     PLOTS
      WRITE(2,106)                                                      PLOTS
      READ *,YAW                                                        PLOTS
      WRITE(2,107)                                                      PLOTS
      READ 112,SUBLINE                                                  PLOTS
      WRITE(2,108)                                                      PLOTS
      READ 112,CPONTZ                                                   PLOTS
  104 FORMAT(" INPUT THE ROLL ANGLE FOR THE AIRCRAFT",/,                PLOTS
     2" (DEG), >360 TO STOP.")                                          PLOTS
  105 FORMAT("PITCH ANGLE")                                             PLOTS
  106 FORMAT("YAW ANGLE")                                               PLOTS
  107 FORMAT("SUBPANELING ?  TRUE OR FALSE")                            PLOTS
  108 FORMAT("CONTROL POINTS ? TRUE OR FALSE")                          PLOTS
  112 FORMAT(L7)                                                        PLOTS
C                                                                       PLOTS
      IF(TESTRTO.LT.1.00)GO TO 500                                      PLOTS
      IF(TESTRTO.GT.1.25)TESTRTO=1.25                                   PLOTS
      RYY=5.0/TESTRTO                                                   PLOTS
      IXX2=INT(TESTRTO*3200)                                            PLOTS
      IXX1=INT((4096-IXX2)*.5)                                          PLOTS
      CALL SWINDO(IXX1,IXX2,1,3200)                                     PLOTS
      CALL DWINDO(-5.0,5.0,-RYY,RYY)                                    PLOTS
      GO TO 501                                                         PLOTS
  500 CALL SWINDO(450,3200,1,3200)                                      PLOTS
      CALL DWINDO(-5.0,5.0,-5.0,5.0)                                    PLOTS
  501 CALL TURNIT(ROLL,PITCH,YAW)                                       PLOTS
    3 CALL MOVABS(100,3500)                                             PLOTS
      CALL ANMODE                                                       PLOTS
```

```
      WRITE(2,788)TITLE,ROLL,PITCH,YAW                                  PLOTS
  788 FORMAT(8A10,/," THE ROLL ANGLE IS  ",F7.1,                        PLOTS
     1/," THE PITCH ANGLE IS ",F7.1,                                    PLOTS
     2/," THE YAW ANGLE IS   ",F7.1)                                    PLOTS
      DO 300 NPANS=1,NPAN                                               PLOTS
      DO 299 L=1,2                                                      PLOTS
      READ(3)NVOR ,RNCV ,PDL,IQUANT,NVRNPRD,ISETS                       PLOTS
      ISET=ISETS                                                        PLOTS
      NVOR1=NVOR+1                                                      PLOTS
      NVRN=NVRNPRD-NVOR1+1                                              PLOTS
      IF(SUBLINE.A.PDL.LT.360)CALL VORSUB(5HLINES,ISETS,3,L)            PLOTS
      IF(.NOT.SUBLINE.A.PDL.GT.360)CALL VORSUB(5HLINES,ISETS,3,L)       PLOTS
      IF(SUBLINE.A.PDL.GT.360)CALL RNDLINE(L)                           PLOTS
      IF(.NOT.SUBLINE.A.PDL.LT.360)CALL VORSUB(5HEDGES,ISETS,3,L)       PLOTS
      IF(PDL.GE.0.0.A.CPONTZ)CALL CPOINTS(L)                            PLOTS
      IF(SUBLINE.A.PDL.GT.360.)ISET=0                                   PLOTS
      IF(L.EQ.2.OR.IQUANT.EQ.1)GO TO 300                                PLOTS
      CALL BACKUP(3,ISET+1)                                             PLOTS
  299 CONTINUE                                                          PLOTS
  300 IF(L.EQ.2.A.ISET.EQ.0.OR.IQUANT.EQ.1.A.ISET.EQ.0)CALL SKPFILE(3,  PLOTS
     1ISETS)                                                            PLOTS
      CALL MOVABS(100,3500)                                             PLOTS
      CALL BIGER(II)                                                    PLOTS
      IF(II-1)9,9,3                                                     PLOTS
      END                                                               PLOTS
C                                                                       PLOTS


      SUBROUTINE VORSUB(WHICH,ISETS,IFILE,L)                            PLOTS
      COMMON /PRAMS/NVOR,NVRNPRD,RNCV,NVOR1,NVRN                        PLOTS
      COMMON VORS(3,500)                                                PLOTS
C                                                                       PLOTS
C       THIS SUBROUTINE PLOTS A FLAT MAJOR PANEL WITH                   PLOTS
C       OR WITHOUT SUBPANELING, OR A CURVED PANEL WITHOUT SUBPANELING.  PLOTS
C                                                                       PLOTS
      CALL SAVE(IFUG,IFILE,IDUM,1,L,ISETS)                              PLOTS
      IF(WHICH.EQ.5HLINES)GO TO 1                                       PLOTS
      N1=NVRN-1                                                         PLOTS
```

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```
      N2=NVOR                                                           PLOTS    106
      GO TO 2                                                           PLOTS    107
    1 N1=NVOR1                                                          PLOTS    108
      N2=1                                                              PLOTS    109
    2 CALL SAVE(IFUG,IFILE,NVRNPRD,2,L,ISETS)                           PLOTS    110
      DO 257 I=1,NVRN,N1                                                PLOTS    111
      DO 257 J=1,NVOR1                                                  PLOTS    112
      I2=I+J-1+IFUG                                                     PLOTS    113
      IF(I2.LE.500)GO TO 3                                              PLOTS    114
   10 I2=I2-500                                                         PLOTS    115
      CALL SAVE(IFUG,IFILE,NVRNPRD,2,L,ISETS)                           PLOTS    116
      IF(I2.GT.500)GO TO 10                                             PLOTS    117
    3 IF(J.EQ.1)CALL MOVEA(VORS(1,I2 ),VORS(3,I2 ))                     PLOTS    118
  257 CALL DRAWA(VORS(1,I2 ),VORS(3,I2 ))                               PLOTS    119
      DO 258 J=1,NVOR1,N2                                               PLOTS    120
      IF(ISETS.EQ.1)GO TO 4                                             PLOTS    121
      CALL BACKUP(IFILE,ISETS)                                          PLOTS    122
      CALL SAVE(IFUG,IFILE,NVRNPRD,1,L,ISETS)                           PLOTS    123
      CALL SAVE(IFUG,IFILE,NVRNPRD,2,L,ISETS)                           PLOTS    124
    4 DO 258 I=1,NVRN,NVOR1                                             PLOTS    125
      I2=I+J-1+IFUG                                                     PLOTS    126
      IF(I2.LE.500)GO TO 5                                              PLOTS    127
      CALL SAVE(IFUG,IFILE,NVRNPRD,2,L,ISETS)                           PLOTS    128
      I2=I2-500                                                         PLOTS    129
    5 IF(I.EQ.1)CALL MOVEA(VORS(1,I2 ),VORS(3,I2 ))                     PLOTS    130
  258 CALL DRAWA(VORS(1,I2 ),VORS(3,I2 ))                               PLOTS    131
      RETURN                                                            PLOTS    132
      END                                                               PLOTS    133
C                                                                       PLOTS    134

      SUBROUTINE REFLECT(N)                                             PLOTS    135
      COMMON VORS(3,500)                                                PLOTS    136
C      THIS SUBROUTINE REFLECTS THE CONFIGURATION ACCROSS ITS X-Z PLANE.PLOTS    137
      DO 1 J=1,N                                                        PLOTS    138
    1 VORS(2,J)=-VORS(2,J)                                              PLOTS    139
      RETURN                                                            PLOTS    140
      END                                                               PLOTS    141
```

```
C
      SUBROUTINE BIGER(I)
C       THIS SUBROUTINE CAUSES A PORTION OF THE PLOT DEFINED WITH
C       THE GRAPHICS CURSER, TO BE ENLARGED.
C
      CALL ANMODE
      WRITE(2,103)
      READ 102, ENLARGE
      IF(ENLARGE.EQ.3HYES)GO TO 1
      I=1
      RETURN
    1 CALL VCURSR(ICHAR,X1,Y1)
      CALL VCURSR(ICHAR,X2,Y2)
      CALL ERASE
      RATIO=(X2-X1)/(Y2-Y1)
      IF(RATIO.LT.1.25)GO TO 10
      IX1=48
      IX2=4096
      IY2=INT(4096/RATIO)
      IY1=INT((3200-IY2)*.5)
      GO TO 20
   10 IY1=1
      IY2=3200
      IX2=INT(3200*RATIO)
      IX1=INT((4098-IX2)*.5)
   20 CALL SWINDO(IX1,IX2,IY1,IY2)
      CALL DWINDO(X1,X2,Y1,Y2)
      REWIND 3
      REWIND 4
      REWIND 5
      READ(3)
      I=2
      RETURN
  102 FORMAT(1A3)
  103 FORMAT(/////," FOR ENLARGEMENT INPUT YES")
      END
```

```
C                                                                PLOTS    178
      SUBROUTINE CPOINTS(L)                                      PLOTS    179
C       THIS SUBROUTINE PLOTS X'S ON THE CONTROL POINTS.         PLOTS    180
      COMMON VORS(3,500)                                         PLOTS    181
      COMMON/PRAMS/NVOR,NVRNPRD,RNCV,NVOR1,NVRN                  PLOTS    182
      INTEGER PRD,RNCV                                           PLOTS    183
      IF(L.EQ.2)CALL BACKUP(4,ISETS+1)                           PLOTS    184
      READ(4)NVOR,RNCV,PRD,NNN,NVRNPRD,NNO,ISETS                 PLOTS    185
      CALL SAVE(IFUG,4,IDUM,1,L,ISETS)                           PLOTS    186
      CALL SAVE(IFUG,4,NNN,2,L,ISETS)                            PLOTS    187
      DO 1 J=1,NNO,NVOR                                          PLOTS    188
      DO 1 I=1,NVOR                                              PLOTS    189
      K=(I+J-2)*4+IFUG                                           PLOTS    190
      K4=K+4                                                     PLOTS    191
      CALL MOVEA(VORS(1,K+1),VORS(3,K+1))                        PLOTS    192
      CALL DRAWA(VORS(1,K+2),VORS(3,K+2))                        PLOTS    193
      CALL MOVEA(VORS(1,K+3),VORS(3,K+3))                        PLOTS    194
      CALL DRAWA(VORS(1, K4),VORS(3, K4))                        PLOTS    195
    1 IF(K4.EQ.500)CALL SAVE(IFUG,4,NNN,2,L,ISETS)               PLOTS    196
      RETURN                                                     PLOTS    197
      END                                                        PLOTS    198
C                                                                PLOTS    199


      SUBROUTINE RNDLINE(L)                                      PLOTS    200
C        THIS DEFINES A SET OF PARAMETERS SO A CURVED MAJOR      PLOTS    201
C        PANEL WITH SUBPANELING CAN BE PLOTED.                   PLOTS    202
      INTEGER RNCV                                               PLOTS    203
      COMMON VORS(3,500)                                         PLOTS    204
      COMMON/PRAMS/NVOR,NVRNPRD,RNCV,NVOR1,NVRN                  PLOTS    205
      IF(L.EQ.2)CALL BACKUP(5,ISETS+1)                           PLOTS    206
      READ(5)NVOR,RNCV,NVRNPRD,ISETS                             PLOTS    207
      NVOR1=NVOR+1                                               PLOTS    208
      NVRN=NVRNPRD-NVOR                                          PLOTS    209
      CALL VORSUB(5HLINES,ISETS,5,L)                             PLOTS    210
      RETURN                                                     PLOTS    211
      END                                                        PLOTS    212
C                                                                PLOTS    213
```

```
      SUBROUTINE SAVE(FUG,FILE,P,TEST,L,SETS)                           PLOTS 214
C      THIS SUBROUTINE MAKES IT POSSIBLE TO REDUCE THE CORE             PLOTS 215
C      REQUIREMENTS OF THE PROGRAM.                                     PLOTS 216
      INTEGER FUG,FILE,P,TEST,SETS                                      PLOTS 217
      COMMON VORS(3,500)                                                PLOTS 218
      COMMON /PRAMS/NVOR,NVRNPRD,RNCV,NVOR1,NVRN                        PLOTS 219
      COMMON/ROT/KARRAY2(7),AMYTRIX(3,3)                                PLOTS 220
      IF(TEST.EQ.1)GO TO 1                                              PLOTS 221
      FUG=-500*TEST2                                                    PLOTS 222
      IF(TEST2.EQ.SETS)RETURN                                           PLOTS 223
      TEST2=TEST2+1                                                     PLOTS 224
      IF(TEST2.LT.SETS)N=500                                            PLOTS 225
      IF(TEST2.EQ.SETS)N=MOD(P,500)                                     PLOTS 226
      IF(N.EQ.0)N=500                                                   PLOTS 227
      READ(FILE)((VORS(I,J),I=1,3),J=1,N)                               PLOTS 228
      IF(L.EQ.2)CALL REFLECT(N)                                         PLOTS 229
      KARRAY2(4)=N                                                      PLOTS 230
      CALL MATOPS(KARRAY2,AMYTRIX,VORS,VORS)                            PLOTS 231
      RETURN                                                            PLOTS 232
    1 TEST2=FUG=0                                                       PLOTS 233
      RETURN                                                            PLOTS 234
      END                                                               PLOTS 235
C                                                                       PLOTS 236


      SUBROUTINE BACKUP(I,N)                                            PLOTS 237
C       CAUSES FILE I TO BE BACKSPACED N RECORDS.                       PLOTS 238
      DO 1 J=1,N                                                        PLOTS 239
    1 BACKSPACE I                                                       PLOTS 240
      RETURN                                                            PLOTS 241
      END                                                               PLOTS 242
C                                                                       PLOTS 243
```

```
      SUBROUTINE SKPFILE(I,N)                                          PLOTS
C      CAUSES FILE I TO BE ADVANCED N RECORDS.                         PLOTS
      DO 1 J=1,N                                                       PLOTS
    1 READ(I)                                                          PLOTS
      RETURN                                                           PLOTS
      END                                                              PLOTS

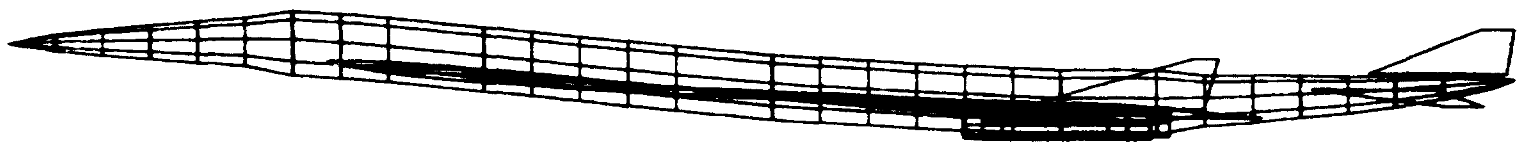

      SUBROUTINE TURNIT(RO,PO,YO)                                      PLOTS
C                                                                      PLOTS
C        THIS SUBROUTINE DETERMINES THE MAYTRIX WHICH WILL ROTATE      PLOTS
C        THE AIRCRAFT THROUGH THE ANGLES ROLL PITCH AND YAW AS         PLOTS
C        THEY ARE NORMALY DETERMINED.                                  PLOTS
C                                                                      PLOTS
      DIMENSION ZAX(3,3),XAX(3,3),R1(3,3),R2(3,3),VECTOR(3)            PLOTS
      DIMENSION KMULT(7),MULTV(7)                                      PLOTS
      COMMON /ROT/ KARRAY2(7),AMYTRIX(3,3)                             PLOTS
      DATA(KMULT(M),M=1,7)/20,6*(3)/                                   PLOTS
      DATA(MULTV(M),M=1,7)/20,3,3,1,3,3,3/                             PLOTS
      DATA PIE/3.14159/                                                PLOTS
      DATA XAX(1,2),XAX(1,3),XAX(2,1),XAX(3,1)/4*(0.0)/                PLOTS
      DATA ZAX(1,3),ZAX(2,3),ZAX(3,1),ZAX(3,2)/4*(0.0)/                PLOTS
      DATA R1(1,2),R1(1,3),R1(2,1),R1(3,1)/4*(0.0)/                    PLOTS
      DATA R2(1,2),R2(2,1),R2(2,3),R2(3,2)/4*(0.0)/                    PLOTS
      DATA XAX(1,1),ZAX(3,3),R1(1,1),R2(2,2)/4*(1.0)/                  PLOTS
    1 AMYTRIX(1,1)=AMYTRIX(2,2)=AMYTRIX(3,3)=1.0                       PLOTS
      AMYTRIX(1,2)=AMYTRIX(1,3)=AMYTRIX(2,1)=AMYTRIX(2,3)=0.0          PLOTS
      AMYTRIX(3,1)=AMYTRIX(3,2)=0.0                                    PLOTS
      VECTOR(1)=VECTOR(2)=0.0                                          PLOTS
      VECTOR(3)=1.0                                                    PLOTS
      R=RO*PIE/180.                                                    PLOTS
      P=-PO*PIE/180.                                                   PLOTS
      Y=-YO*PIE/180.                                                   PLOTS
      RTO=PIE*.5-R                                                     PLOTS
      XAX(2,2)=XAX(3,3)=COS(R)                                         PLOTS
      SINE=SIN(R)                                                      PLOTS
      XAX(2,3)=SINE                                                    PLOTS
      XAX(3,2)=-SINE                                                   PLOTS
```

```
      ZAX(1,1)=ZAX(2,2)=COS(P)                                          PLOTS 280
      SINE=SIN(P)                                                       PLOTS 281
      ZAX(1,2)=-SINE                                                    PLOTS 282
      ZAX(2,1)=SINE                                                     PLOTS 283
      R1(2,2)=R1(3,3)=COS(RTO)                                          PLOTS 284
      SINE=SIN(RTO)                                                     PLOTS 285
      R1(2,3)=SINE                                                      PLOTS 286
      R1(3,2)=-SINE                                                     PLOTS 287
      CALL MATOPS(KMULT,XAX,AMYTRIX,AMYTRIX)                            PLOTS 288
      CALL MATOPS(KMULT,R1,AMYTRIX,AMYTRIX)                             PLOTS 289
      CALL MATOPS(KMULT,ZAX,AMYTRIX,AMYTRIX)                            PLOTS 290
C        TRANSPOSE MAYTRIX R1.                                          PLOTS 291
      R1(2,3)=-SINE                                                     PLOTS 292
      R1(3,2)=SINE                                                      PLOTS 293
      CALL MATOPS(KMULT,R1,AMYTRIX,AMYTRIX)                             PLOTS 294
    5 ZAX(1,1)=ZAX(2,2)=COS(Y)                                          PLOTS 295
      SINE=SIN(Y)                                                       PLOTS 296
      ZAX(1,2)=-SINE                                                    PLOTS 297
      ZAX(2,1)=SINE                                                     PLOTS 298
      CALL MATOPS(MULTV,AMYTRIX,VECTOR,VECTOR)                          PLOTS 299
      A=VECTOR(1)                                                       PLOTS 300
      B=VECTOR(2)                                                       PLOTS 301
      C=VECTOR(3)                                                       PLOTS 302
      V=SQRT(B*B+C*C)                                                   PLOTS 303
      BOVRV=B/V                                                         PLOTS 304
      R1(2,2)=R1(3,3)=C/V                                               PLOTS 305
      R1(2,3)=-BOVRV                                                    PLOTS 306
      R1(3,2)=BOVRV                                                     PLOTS 307
      R2(1,1)=R2(3,3)=V                                                 PLOTS 308
      R2(1,3)=-A                                                        PLOTS 309
      R2(3,1)=A                                                         PLOTS 310
      CALL MATOPS(KMULT,R1,AMYTRIX,AMYTRIX)                             PLOTS 311
      CALL MATOPS(KMULT,R2,AMYTRIX,AMYTRIX)                             PLOTS 312
      CALL MATOPS(KMULT,ZAX,AMYTRIX,AMYTRIX)                            PLOTS 313
C         TRANSPOSE MAYTRIX R1 AND MAYTRIX R2.                          PLOTS 314
      R1(2,3)=BOVRV                                                     PLOTS 315
```

```
      R1(3,2)=-BOVRV                                                    PLOTS     316
      R2(1,3)=+A                                                        PLOTS     317
      R2(3,1)=-A                                                        PLOTS     318
      CALL MATOPS(KMULT,R2,AMYTRIX,AMYTRIX)                             PLOTS     319
      CALL MATOPS(KMULT,R1,AMYTRIX,AMYTRIX)                             PLOTS     320
      RETURN                                                            PLOTS     321
      END                                                               PLOTS     322
```

```
AST 100 - 6/6/75 PER COORD SHEET 164(REVISED),712 LB/SEC ENGINES (AST-JP-2)
 THE ROLL ANGLE IS       0.0
 THE PITCH ANGLE IS      0.0
 THE YAW ANGLE IS        0.0

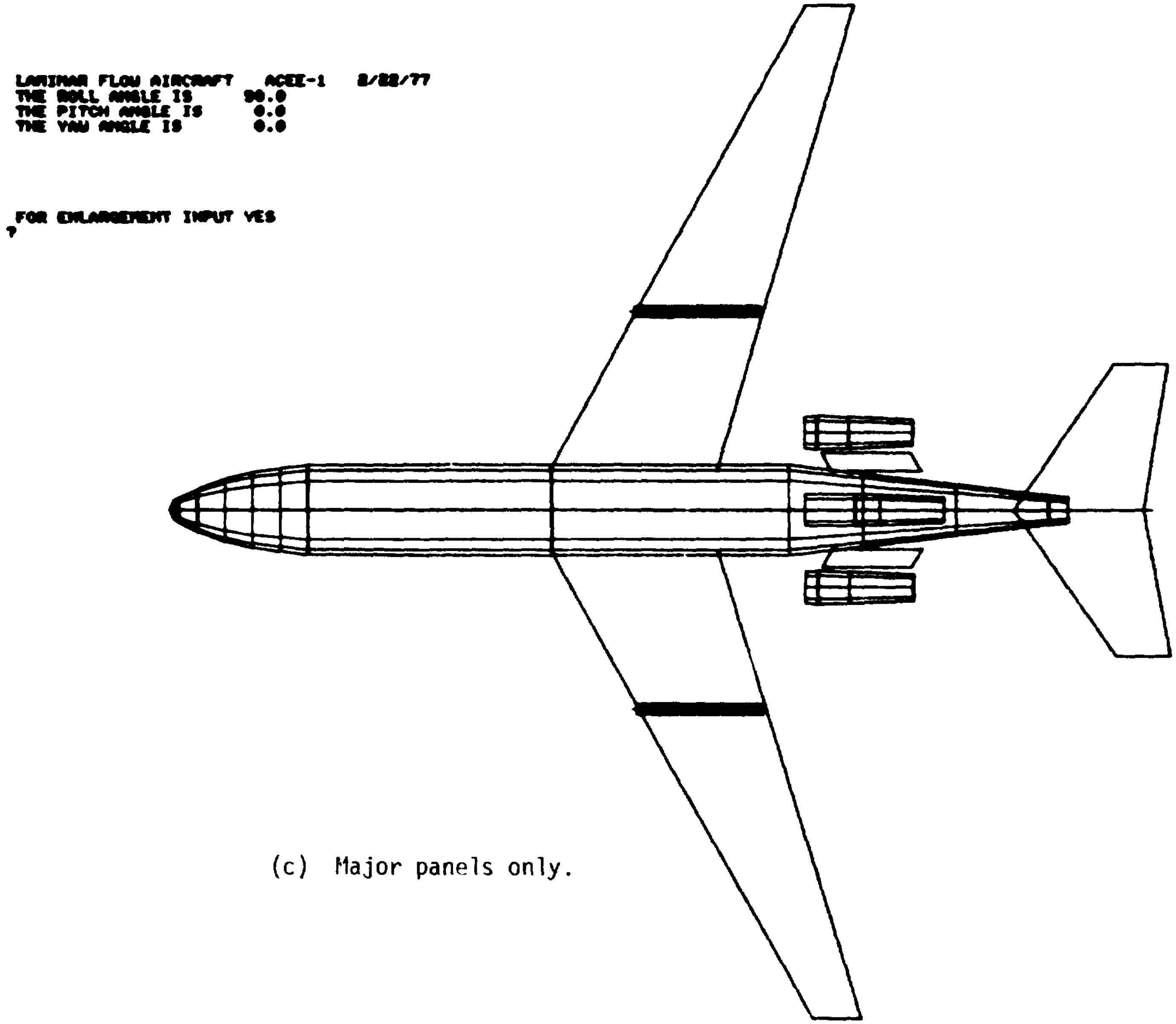
 FOR ENLARGEMENT INPUT YES
?
```



(a) With panel camber displayed.

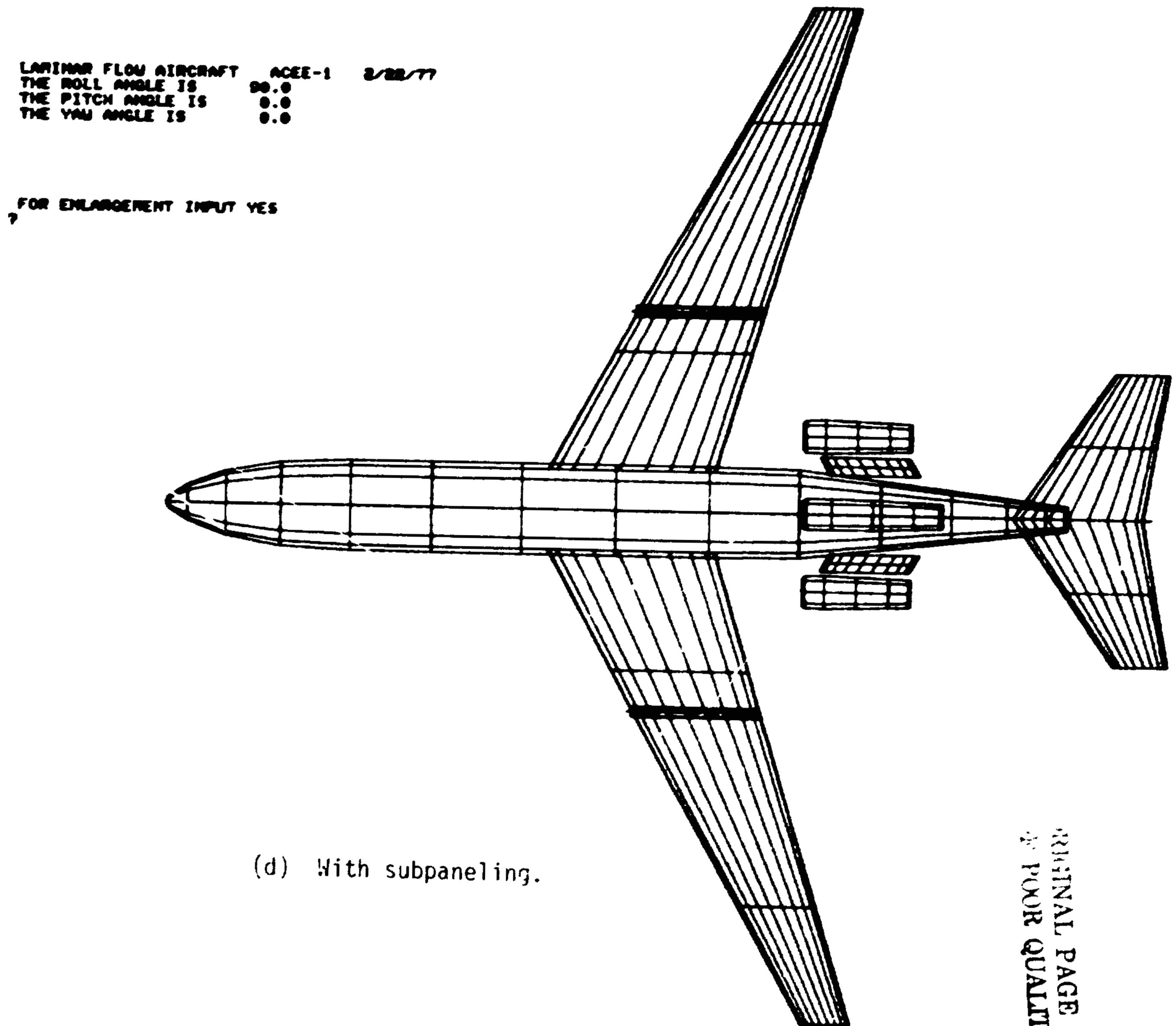
(b) Without panel camber displayed.

Figure 1. - Display of aircraft configuration.



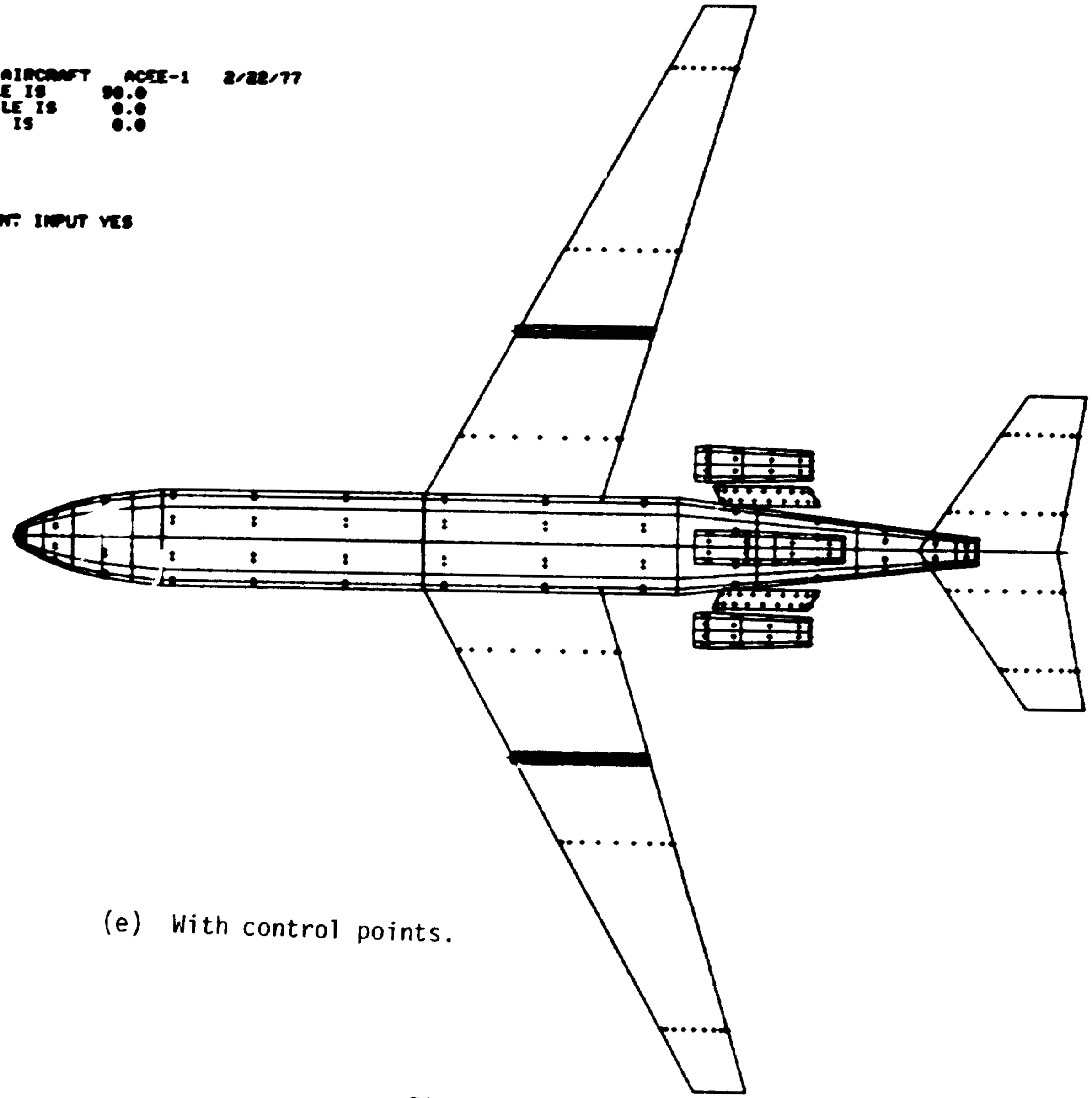
(c) Major panels only.

Figure 1. - Continued.



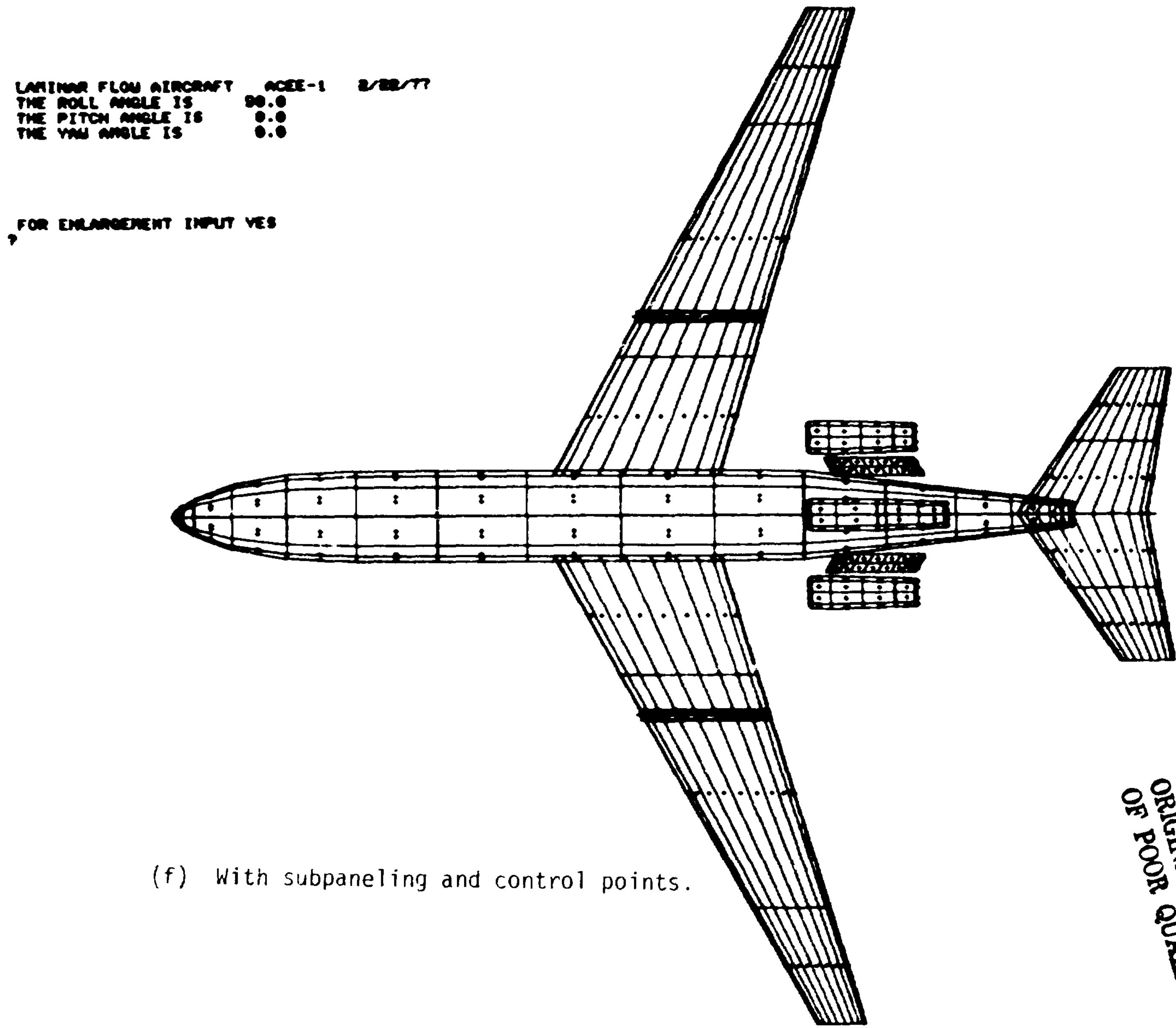
(d) With subpaneling.

Figure 1. - Continued.



(e) With control points.

Figure 1. - Continued.



(f) With subpaneling and control points.

Figure 1. - Concluded.

```
/GET,PLOTIT/UN=214737C
/CALL,PLOTIT(T=VORLAXX)
DO YOU WANT CAMBER IN THE PANELS ?
TRUE OR FALSE
? TRUE

 INPUT THE ROLL ANGLE FOR THE AIRCRAFT
 (DEG), >360 TO STOP.
? 11
PITCH ANGLE
? 12
YAW ANGLE
? 13
SUBPANELING ?  TRUE OR FALSE
? TRUE
CONTROL POINTS ? TRUE OR FALSE
? TRUE
```

Figure 2. - Sample execution of program PLOTIT.

```
LAMINAR FLOW AIRCRAFT   ACEE-1   2/22/77
THE ROLL ANGLE IS      11.0
THE PITCH ANGLE IS     12.0
THE YAW ANGLE IS       13.0


FOR ENLARGEMENT INPUT YES
?
```

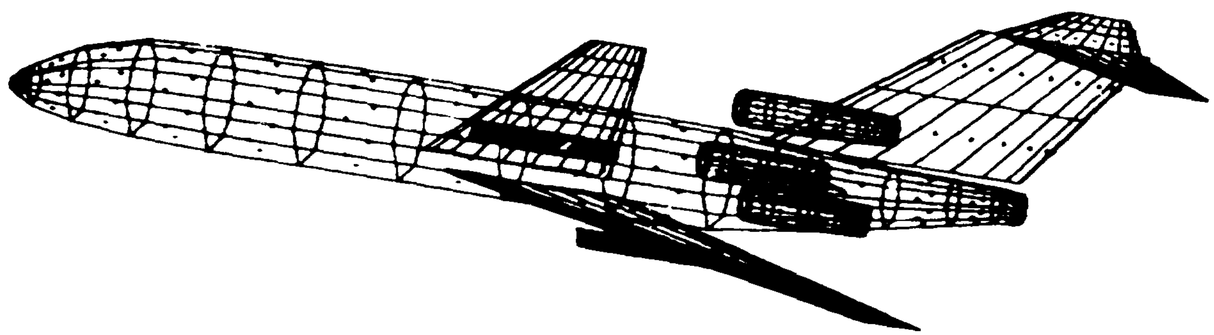
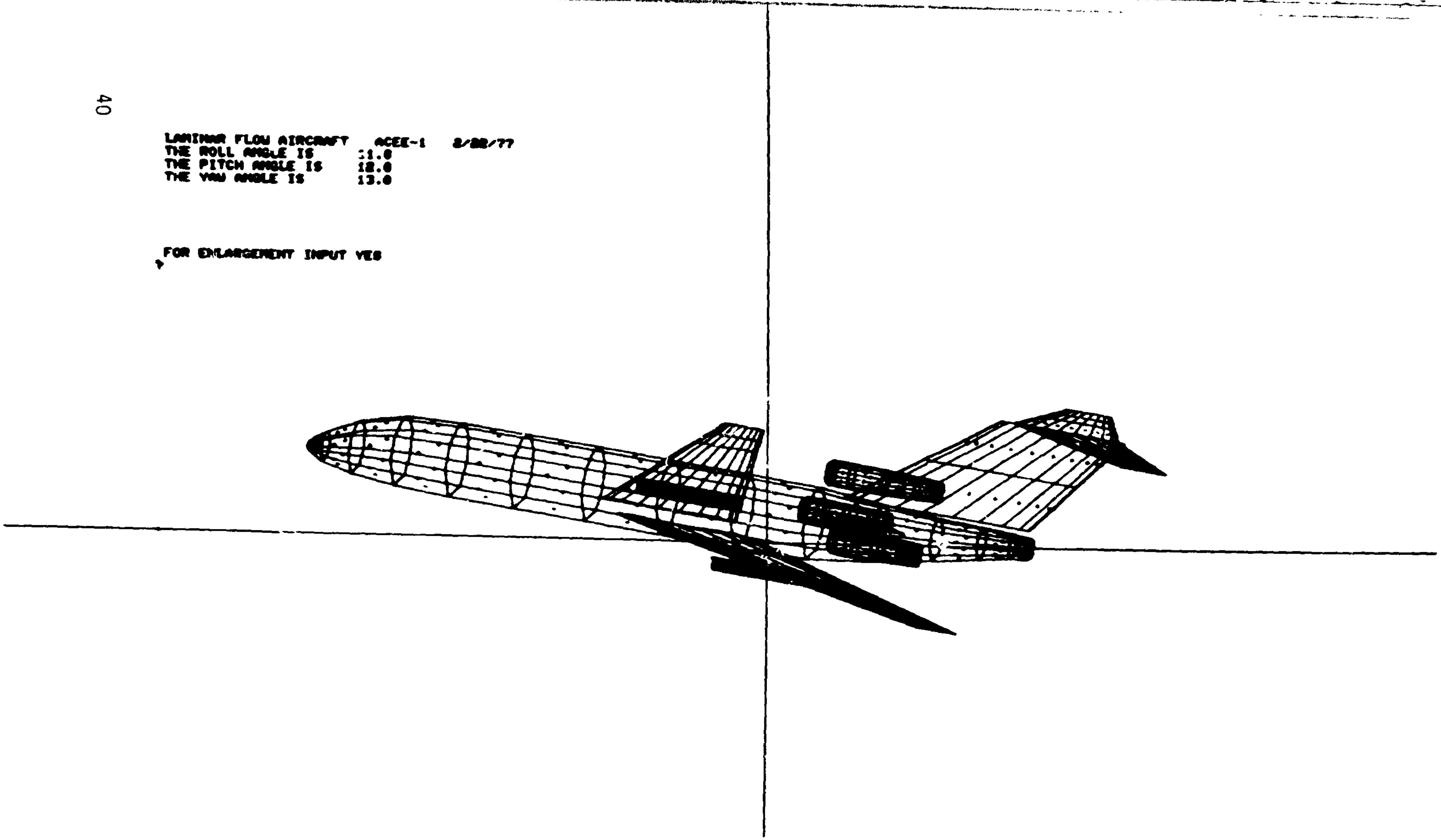
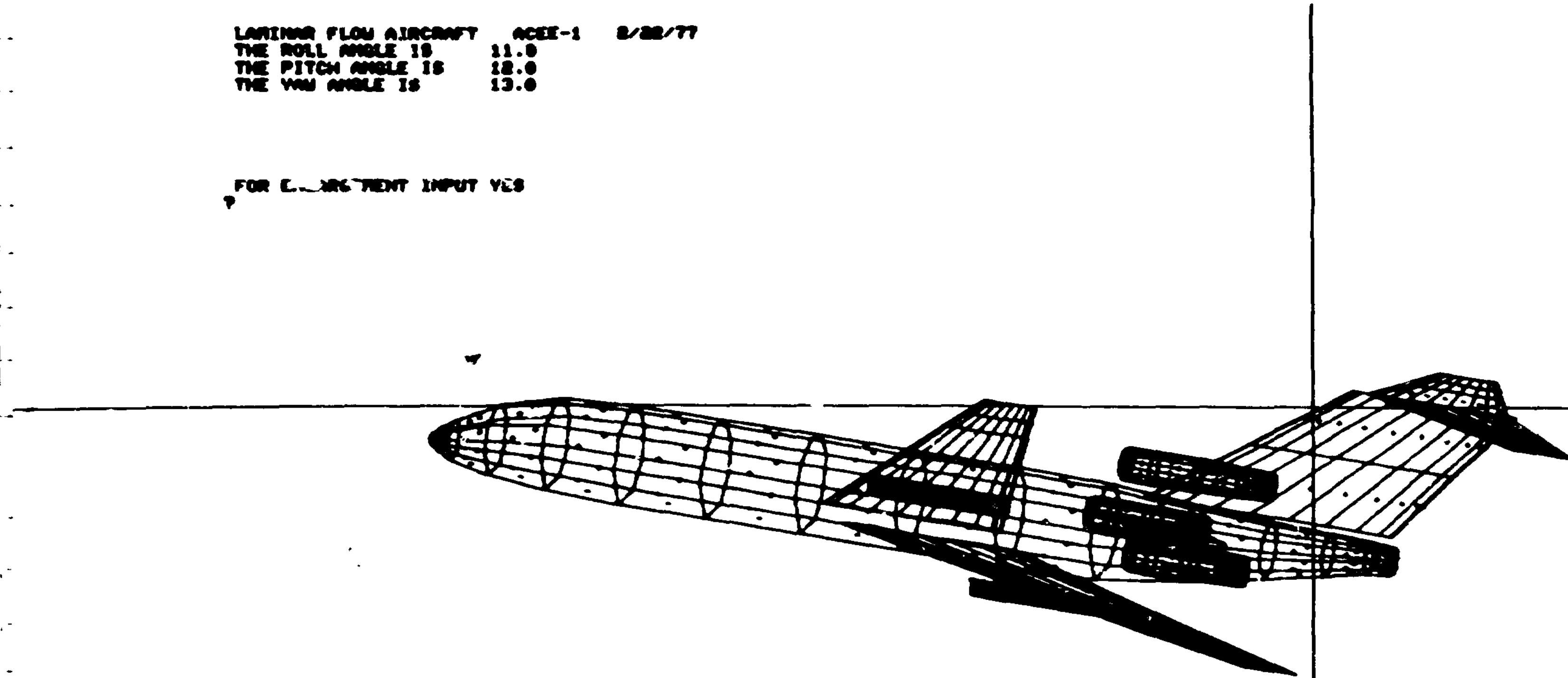


Figure 3. - Plot from sample execution in figure 2.



(a) First location of graphics cursor.

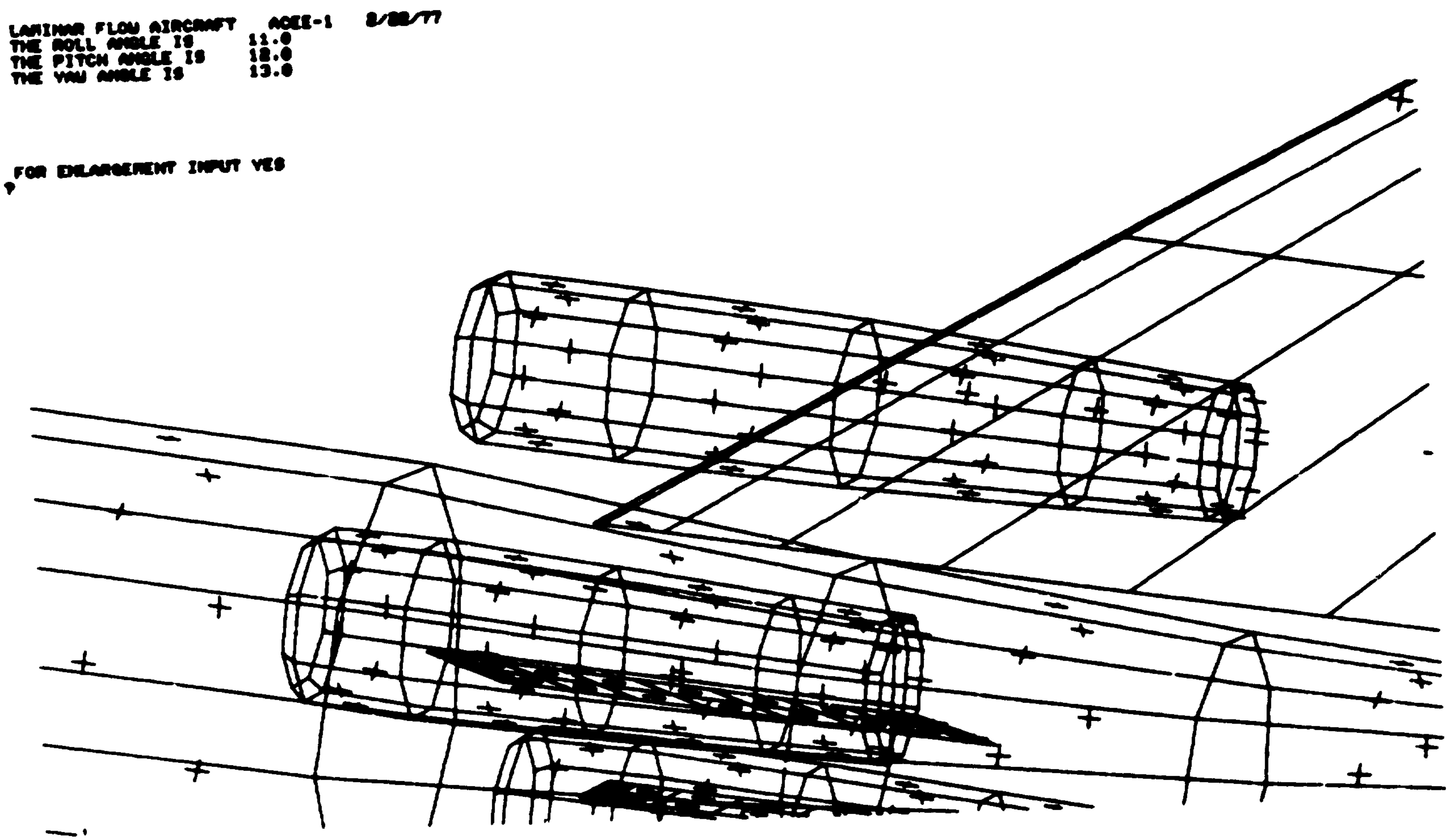
Figure 4. - Use of graphics cursor to enlarge a section of a configuration plot.



(b) Second location of graphics cursor.

Figure 4. - Continued.

ORIGINAL PAGE IS
OF POOR QUALITY



(c) Enlarged plot resulting from cursor locations in figure 4 part (a) and part (b).

Figure 4. - Concluded.